SNI

Standar Nasional Indonesia

SNI 15-0048-2005

Tempered Safety Glass for Road Vehicles

ICS 43.040.60

Badan Standardisasi Nasional

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Translation Disclaimer

Should confusion arise in the interpretation of the English version of this SNI, please refer to the Indonesian version

Table of Content

Foreword

Standar Nasional Indonesia (SNI) on tempered safety glass for road vehicles constitutes a revision from SNI-15-0048-1998. This revision is to equalize the perception and adjustment to the existing technology.

This standard uses regional standard references or other country's standards with high competitiveness value, however, by not disregarding the ability of Indonesian glass manufacturers.

This standard has been discussed in consensus meeting in Jakarta on January 21, 2004 attended by representatives from testing centers, manufacturers, customers, associations and related institutions.

This standard is composed by Engineering Committee 33S, Non Organic Chemistry.

Tempered Safety Glass for Road Vehicles

1 Scope

This standard covers the scopes, normative references, terms and definitions, classifications, quality requirements, samplings, pass requirements, testing methods, marking requirements and packaging of fully tempered and zone tempered safety glass for road vehicles.

2 Terms and Definitions

2.1

Safety Glass (General Definition), Colored or Uncolored

When the glass is broken, the glass should not jeopardize the driver or causing severe physical damage like ordinary glasses.

2.2

Safety Glass for Windscreen

Safety glass as mentioned at point 2.1 should not distracting driver's sight of an object at the front of vehicle and if broken the driver is still be able to see clearly forward and safely stop the vehicle.

2.3

Tempered Safety Glass

With the application of pre-tension process, the glass is processed to become a safety glass, so when it is broken the glasses will be shattered into small pieces.

NOTE

The purpose of pre-tension process is to increase glass resistance against external forces and temperature changes. This pre-tension process is applied equally through out the glass surface, unless provided otherwise. Shapes of this safety glass are flat and curve. Pre-tension process is started by heating process and then immediately followed by cooling process.

2.4

Zone Tempered Safety Glass

Certain zone on safety glass which undergoes different tempered treatment, when it is broken, the fractures on that zone will be larger compared to the other, therefore, the driver's sight will be better comparing to the other zone. At least 60 mm of the

peripheral zone of surrounding glass should be able to break into small pieces.

NOTE

In practice, this safety glass is made into two adjacent pieces, left and right with minimum 400 mm x 150 mm of glass zone undergoes special tempered treatment.

2.5

Optical Distortion

Object refraction which seen through the windscreen is caused by lack of optical quality of glazing material.

3 Classifications

3.1 Classifications of tempered safety glass are based on tables and its shapes as follows:

3.1.1 Flat tempered safety glass

(1) Thickness 3.1 mm

(2) Thickness 3.5 mm

(3) Thickness 4.0 mm

(4) Thickness 5.0 mm

(5) Thickness 6.0 mm

3.1.2. Curve tempered safety glass

(1) Thickness 3.1 mm

(2) Thickness 3.5 mm

(3) Thickness 4.0 mm

(4) Thickness 5.0 mm

(5) Thickness 6.0 mm

3.2 Tempered safety glass is divided into 3 (three) sizes, based on its surface as illustrated at table 1

Table 1 Tempered safety glass classification based on its surface

size	Surface (Lp), m^2
Small	LP < 0.3
Medium	0.3 ≤ LP < 0.8
Large	LP ≥ 0.8

4 Quality Requirements

4.1 Visible Characteristic

Visible characteristic of tempered safety glass for road vehicles should comply with table 2 if tested in accordance with point 6.1.

Table 2

Visible Defect

No.	Types of Defect	Requirements
1	Fraction	Free from large fractions or fractions with length more than the glass thickness.
2	Scratch	a. Windscreen Inside Visibility Zone Heavy scratch, length (1.0-7.0) mm. Medium scratch, length (5.0-30.0) mm. Amount of scratch in sizes above is maximum 1 (one) scratch within diameter of 300 mm. Outside Visibility zone Heavy scratch*), length (3.0-15.0) mm. Medium scratch **), length (5.0-30.0) mm. Amount of scratch in sizes above is maximum 1 (one) scratch within diameter of (500 x 150) mm^2.

		b. Other than windscreen Heavy scratch *), length (3.0-15.0) mm. Medium scratch **), length (5.0-30.0) mm. Maximum amount of scratches in sizes above are 5 (five) scratches within diameter of 300 mm, however, only 1 (one) heavy scratch with length (10-15) mm is allowed in that diameter.
3	Stain on glass	a. Windscreen In Visibility zone Radius of (0.5 – 1.0) mm. Amount of stains within previously mentioned size are limited to 3 (three) stains in an area with diameter of 300 mm. Outside Visibility zone Radius of (0.5 – 1.5) mm. Amount of stains within previously mentioned size are limited to 5 (five) stains in an area with diameter of (150 x 500) mm^2 b. Other than windscreen Amount of stains within previously mentioned size are limited to 5 (five) stains in an area with diameter of 300 mm.

NOTE

*) Heavy scratch is a scratch which can be felt by fingertips.

**) Medium scratch is a scratch which cannot to be felt by fingertips.

4.2 Dimensions and Tolerances

4.2.1 Length and width tolerance of tempered safety glass should be in accordance with table 3 below:

Table 3 Length and Width Tolerance

in mm

Tolerance		
Small	Medium	Large
2	3	4

NOTE

Tolerance of 2 mm refers to the absolute value of its tolerance for respective samples.

e.g.:

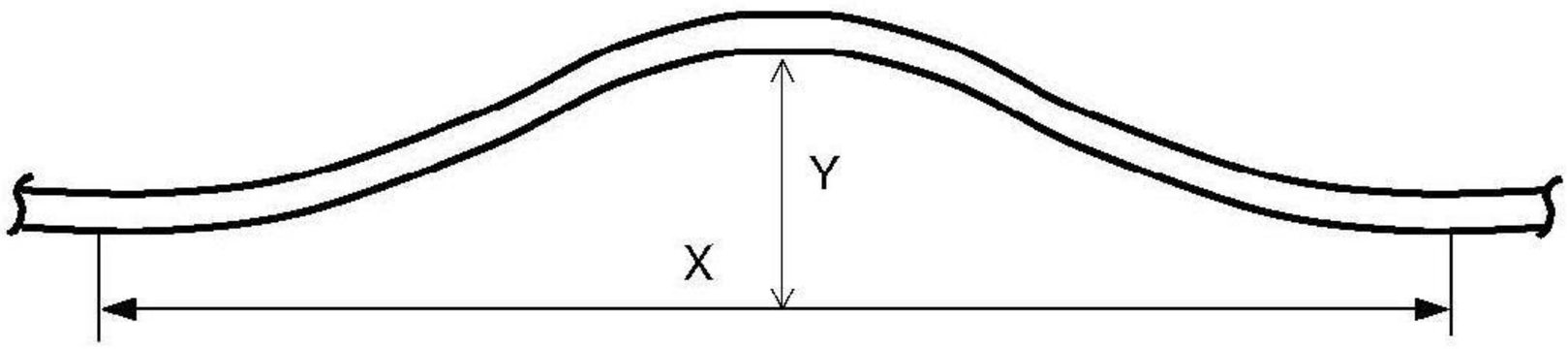
(-0 + 2) ; (-2 + 0) ; (-1 + 1)

(-0.5 + 1.5) and so on

4.2.2 Thickness tolerance of safety glass which have been tempered for ± 0.3 mm from its nominal thickness.

4.3 Flatness

Flatness of tempered safety glass for road vehicles when tested in accordance with point 6.3 should not exceeds 0.5 % on the curve shape and 0.3 % on wave shape (see Figure 1). Curve glass is excluded from this requirement.



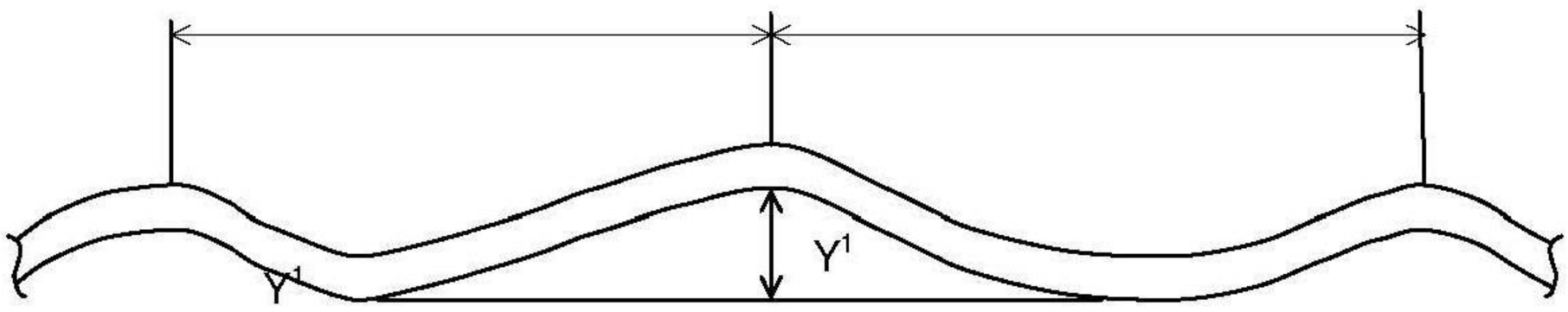
$$\frac{Y}{X} \times 100\ \% \leq 0.5\ \%$$

where:

X is the length of curve arch;

Y is the altitude or depth of curve (arch).

Figure 1a Types of Curve



$$\frac{Y^1}{X^1} \times 100\ \% \leq 0.3\ \%$$

where:

X^1 is the distance between the highest wave peaks to the nearest wave peak;

Y^1 is the highest wave peak.

Figure 1b Types of Wave

4.4 Fragmentation

4.4.1 Fully Tempered Safety Glass

Fragmentation test on fully tempered safety glass is to test whether the fractions causing any danger when the glass is broken.

a. The fragmentation test for ≤ 5 mm fully tempered safety glass in accordance with point 6.4.1.1 should comply with requirements on Table 4 below:

Table 4

Fraction Requirements for Fully Tempered Safety Glass

Classifications	Fraction Condition
Fully Tempered Safety Glass	1. Minimum fractions in an area of 50 mm x 50 mm are 40 pieces and maximum fractions are 400 pieces. For glass with 3.5 mm thickness, the minimum fractions are 40 pieces and maximum fractions are 450 pieces. Total allowed fractions in an area of 50 mm x 50 mm are less than 40 pieces provided that in an area of 100 mm x 100 mm (including in an area of 50 mm x 50 mm above) the minimum fractions are 160 pieces. 2. Total maximum fractions in an area more than 3 cm^2 are 3 pieces in entire calculation zones and maximum 1 piece in circle within diameter of 100 mm. 3. Maximum sharp fractions with length more than 75 mm but less than 150 mm are 5 pieces. 4. Sharp fractions should form maximum 45° angle against the peripheral zone of glass with its length less than 75 mm

b. In accordance with point 6.4.1.1 or point 6.4.1.2, an alternative testing method can be applied if glass thickness is less than 5 mm and the largest fraction

should have maximum weight of 4.25 grams.

4.4.2 Zone Tempered Safety Glass

The purpose of fragmentation test on zone tempered safety glass is to analyze, when the glass is broken, whether its fractions including fractions in visibility zone is not jeopardize the driver and he is still be able to see clearly through the certain zone of the glass. The fragmentation test for zone tempered safety glass in accordance with point 6.4.2 should comply with table 5 below:

Table 5

Fraction Requirements for Zone Tempered Safety Glass

No	Tested Zone	Amount of fractions or its size
1	Peripheral zone	1. Minimum fractions in an area of 50 mm x 50 mm are 40 pieces and maximum fractions are 350 pieces. If amount of fractions in an area of 50 mm x 50 mm less than 40 pieces, it is allowable if the minimum fractions in an area of 100 mm x 100 mm (including in an area of 50 mm x 50 mm above) are 160 pieces. 2. Maximum fractions in an area more than 3 cm^2 are 3 pieces and maximum fraction in a circle with diameter of 100 mm is 1 piece. 3. Maximum of sharp fractions with length more than 75 mm but not exceeds 150 mm are 5 pieces. 4. Sharp fractions should form maximum 45° angle against the glass peripheral zone with its length less than 75 mm.
2	Visibility zone	1. Amount of fractions with minimum size of 2 cm^2

		should represent 15 % minimum of an area of 500 mm x 200 mm. If the glass height less than 440 mm or mounting angle less than 15°, the 10 % minimum of an area of 500 mm x 200 mm or 150 mm x 150 mm for glass with height less than 440 mm. 2. Maximum fractions with size more than 16 cm^2 but less than 25 cm^2 are 3 pieces in radius of 100 mm from breaking point and less than 8 pieces in all visibility zones. 3. Maximum sharp fractions with length more than 100 mm but less than 175 mm are 4 pieces. 4. Maximum sharp fractions in an area of more than 2 cm^2 and cuts the circle with diameter of 44 mm are 10 pieces in an area of 500 mm x 200 mm and 25 pieces in all visibility zones.
3	Intermediate zone	Fractions in this zone should have characteristic between allowable fraction for peripheral zone and visibility zone.

NOTE

The calculation should exclude the area of 20 mm around the peripheral zone and radius of 75 mm from breaking point.

4.5 Crash Resistance

The purpose of crash resistance test is to analyze the glass minimum strength when crashes with flying hard object. The glass should not be broken if tempered safety glass for road vehicles is tested in accordance with point 6.5.

4.6 Light Transmission

The purpose of light transmission test is to analyze whether the light transmission of tempered safety glass fulfill the minimum criteria for driver's visibility.

Tempered safety glass should comply with the light transmission rules. Vehicle light transmission shall be tested in accordance with point butir 6.6 and minimum standard of light transmission resulted by the illuminator standar should be in 70 % and transparent.

4.7 Optical Refraction

The purpose of optical refraction test is to analyze whether the sample's reflection separation causing deviation on driver's visibility or not.

If testing on zone tempered safety glass for windscreen or front door is in accordance with point 6.7, the result should be as illustrated in Table 6.

Table 6 Optical Refraction

Testing Zone		Maximum Friction (minute arch)
Windscreen	Front Door	
A or a	-	15
B or b	D	25
I or c	-	15
-	E	25

4.8 Optical Distortion

The purpose of optical distortion test is to analyze whether the distortion caused by the sample is distracting driver's visibility or not.

If testing on zone tempered safety glass for windscreen is in accordance with point 6.8, the result should comply with one of requirements as follows:

4.8.1 If using circle projection, it should comply with the provision of table 7.

Table 7 Optical Distortion

Testing Zone		Maximum Friction (minute arch)
Windscreen	Front Door	
A or a	-	2
B or b	D	6
I or c	-	2
-	E	6

4.8.2 If using lined screen, it should comply the stipulation as follows:

a. Should not producing reflection which separated from projected lines, and ease to be seen with normal eye.

b. Projection lines obtained are allowable to be relatively curved upon the lines on the screen. However, said projection lines should not exceeds or wedged with the lines on the screen. This meant that it should be equal to maximum primary deviation ± 8.4 minutes (0^o 8.4') arch.

5 Sampling Methods

5.1 Sampling can only be done by the authorized officer

5.2 Sampling shall be in random order with double sampling plan, on Appendix B.

NOTE Double sampling plan is a sampling method where there will be second sampling in case the first sampling is failed.

5.2.1 If sample to be taken is a sample in original size which has been packed, the packaging selection shall be done by lottery or by using random table or random generator on scientific calculator. If amount of samples in that packaging is not sufficient, selection of other packaging shall be done in accordance with method above. If amount of samples in selected packaging exceeds the samples required, samples selection shall be determined by lottery.

5.2.2 For test sample which prepared for crash resistance test and light transmission test for road vehicles, the preparation should be witnessed by sampling officer with material same as original size of the glass in accordance with point 5.2.1.

5.3 The size of sample shall be in accordance with table 9, sample amount and pass requirements.

5.4 Total of minimum sample should be in accordance with table 9, sample amount and pass requirements.

6 Testing Methods

6.1 Visible Characteristic

Visible characteristic test is performed visually on distance of 50 cm from test sample surface (without optical device). If necessary, the testing shall be performed under a bright light. Surveillance shall be performed on the inside and outside of test sample surface.

6.2 Dimension and Tolerance

6.2.1 Length and Width

Metering of length and width should be done by meter with tolerance up to 1 mm.

6.2.2 Thickness

Thickness metering should be done by micrometer with tolerance up to minimum 0.01 mm and its result shall be rounded up to two digits in millimeter.

6.3 Flatness

Flatness metering should be done by a linear measuring stick which applied vertically on test sample. In case of curve, flatness shall be determined in percentage of comparison between curve's height and length. In case of wave, flatness shall be determined in percentage of comparison of altitude of the largest wave with distance between said waves and the nearest wave peak.

6.4 Fragmentation

6.4.1 Fully Tempered Safety Glass.

6.4.1.1 For thickness less than 5 mm.

6.4.1.1.1 Fragmentation test on Fully Tempered safety glass

Sample should be packaged in such way so when it is broken the fractions are not scattered. Sample has to be wracked by a sharp steel hammer with radius (0.2 ± 0.05) mm. Breaking points should be selected as follows:

Breaking Point 1:

At30mm from peripheral zone with smallest angle.

Breaking Point 2:

At 30 mm from peripheral zone at the longest or the shortest side. If marks barrel available on that side, it should be chosen as breaking point.

Breaking Point 3:

Around center point of the glass.

Breaking Point 4:

Only for multi radius glass.

Breaking Point is selected on the longest median line with the shortest curvature radius.

Breaking point position can be viewed at Figure 2a, Figure 2b and Figure 2c.

Breaking point 1, breaking point 2, and breaking point 4 are shown more than one position, but only one position is pursuant to requirements above as the breaking point.

- Amount of the most smooth and rough glass fractions counted in an area of 50 mm x 50 mm or 100 mm x 100 mm (including in an area of 50 mm x 50 mm above), unless for area around 20 mm in peripheral zone and in an area of 75 mm around breaking point and fraction located at square line calculated as half fraction.
- Calculate the total fraction in an area of 3 cm.
- Calculate the total fraction in length of 75 mm.
- Measure the angle formed between fraction length and peripheral zone.
- In an area of 20 mm around the glass and 75 mm from breaking point will not be counted unless for fraction length until the peripheral zone.

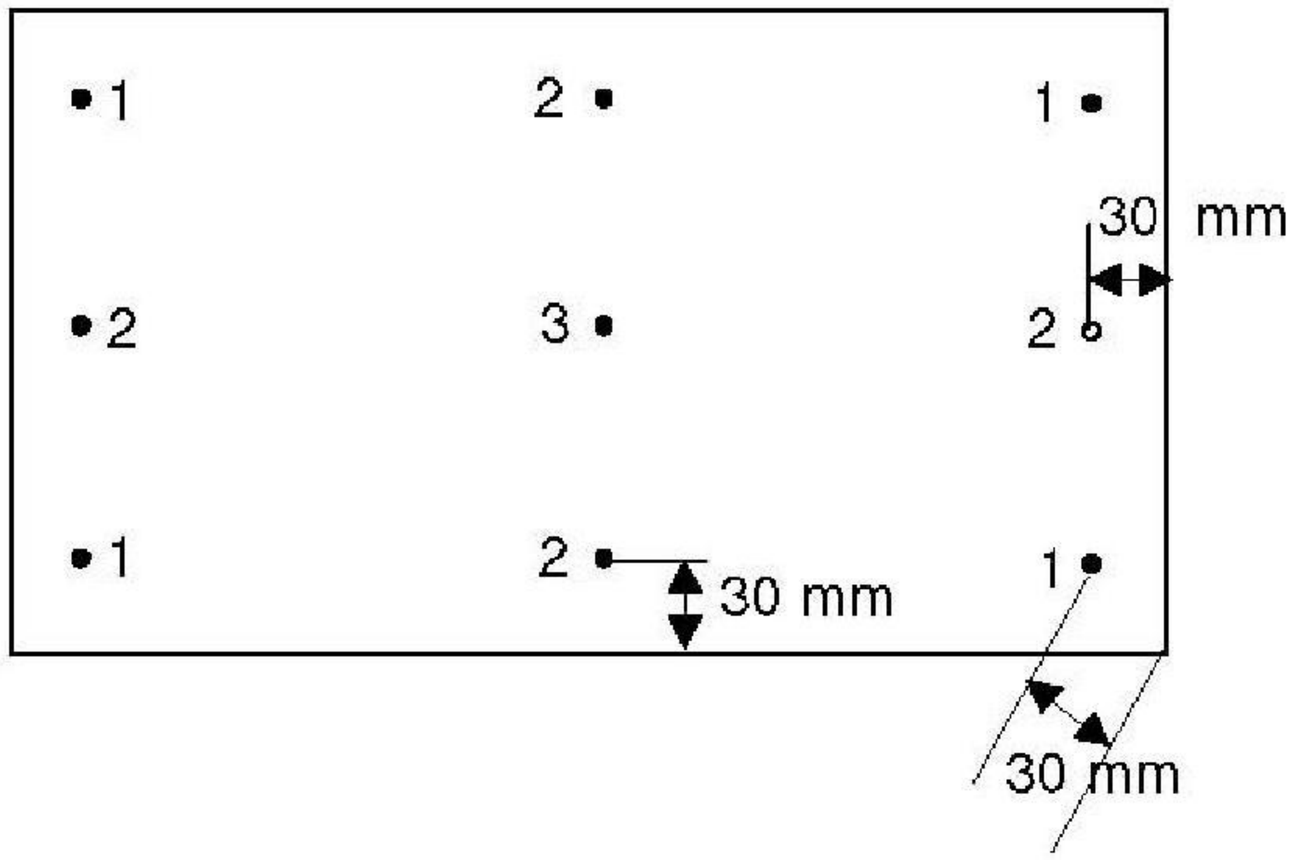


Figure 2a

Breaking point position of fully tempered safety glass, flat or curve in single radius

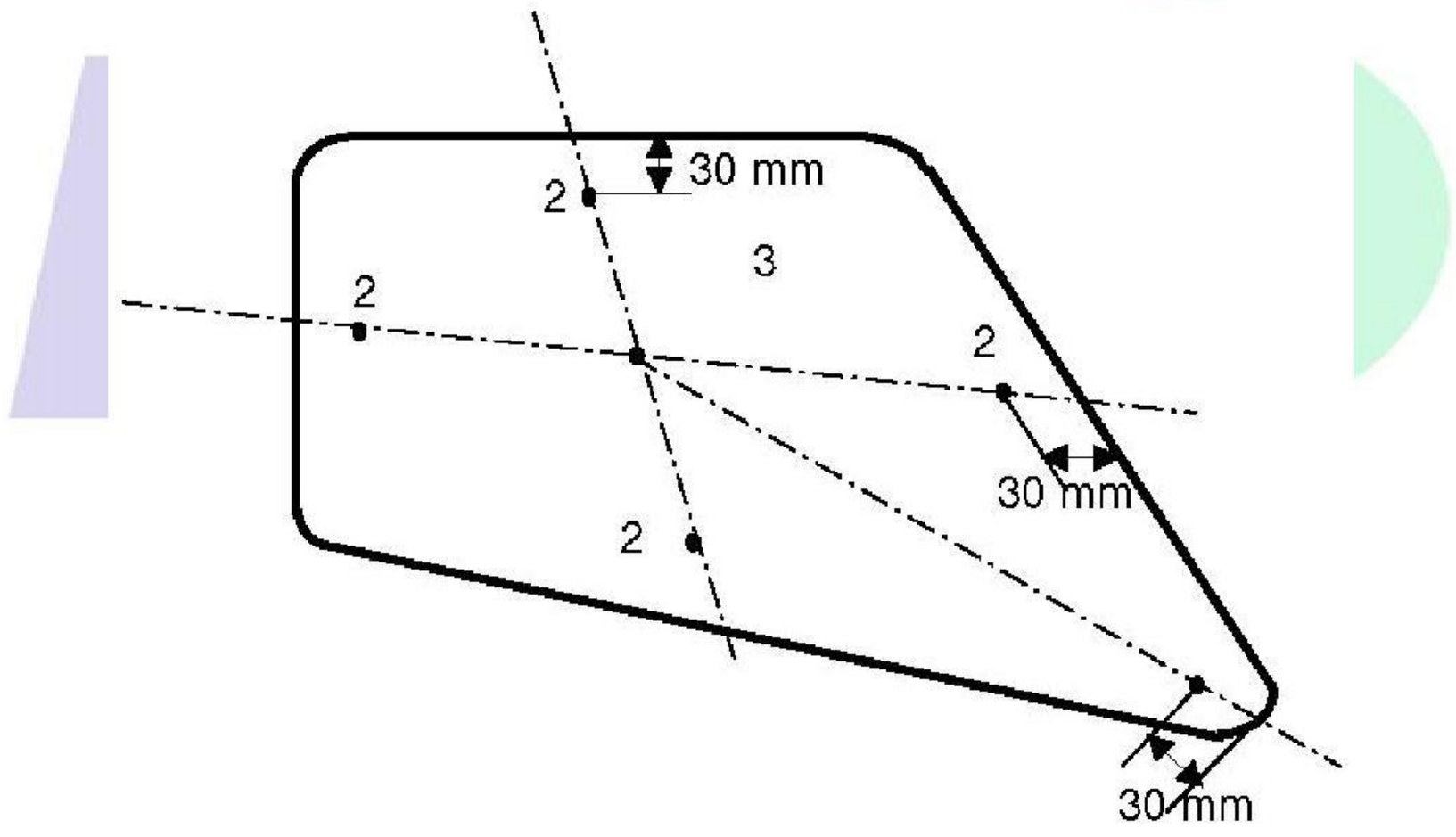


Figure 2b

Breaking point position of fully tempered safety glass, flat or curve in single radius

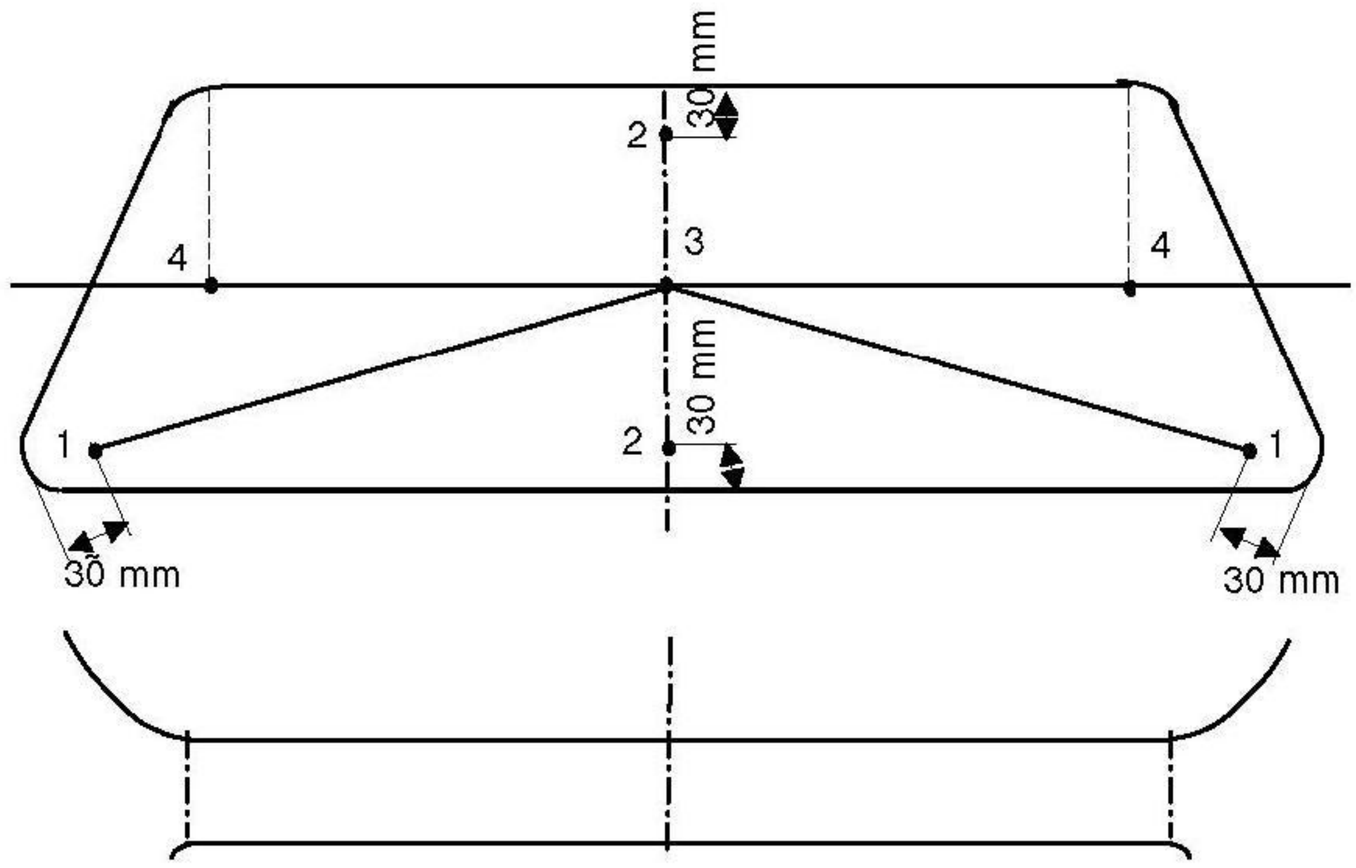


Figure 2c

Breaking point position of

fully tempered safety glass, multi radius

6.4.1.2 Thickness less than 5 mm

Testing method is performed in accordance with point 7.5 of crash resistance test is started at the altitude of 3 meters until test sample is broken by raising the altitude of the ball gradually by 30 cm.

6.4.2 Zone Tempered Safety Glass

a) Sample should be packaged in such way so when it is broken the fractions are not scattered.

b) Sample has to be wracked by a sharp steel hammer in radius of (0.2 ± 0.05) mm. Breaking points should be selected as illustrated at figure 3 according with visibility zone on respective glass sample.

c) Amount of fractions of zone tempered safety glass in zones refer to figure 3 and its requirements should be in accordance with table 5.

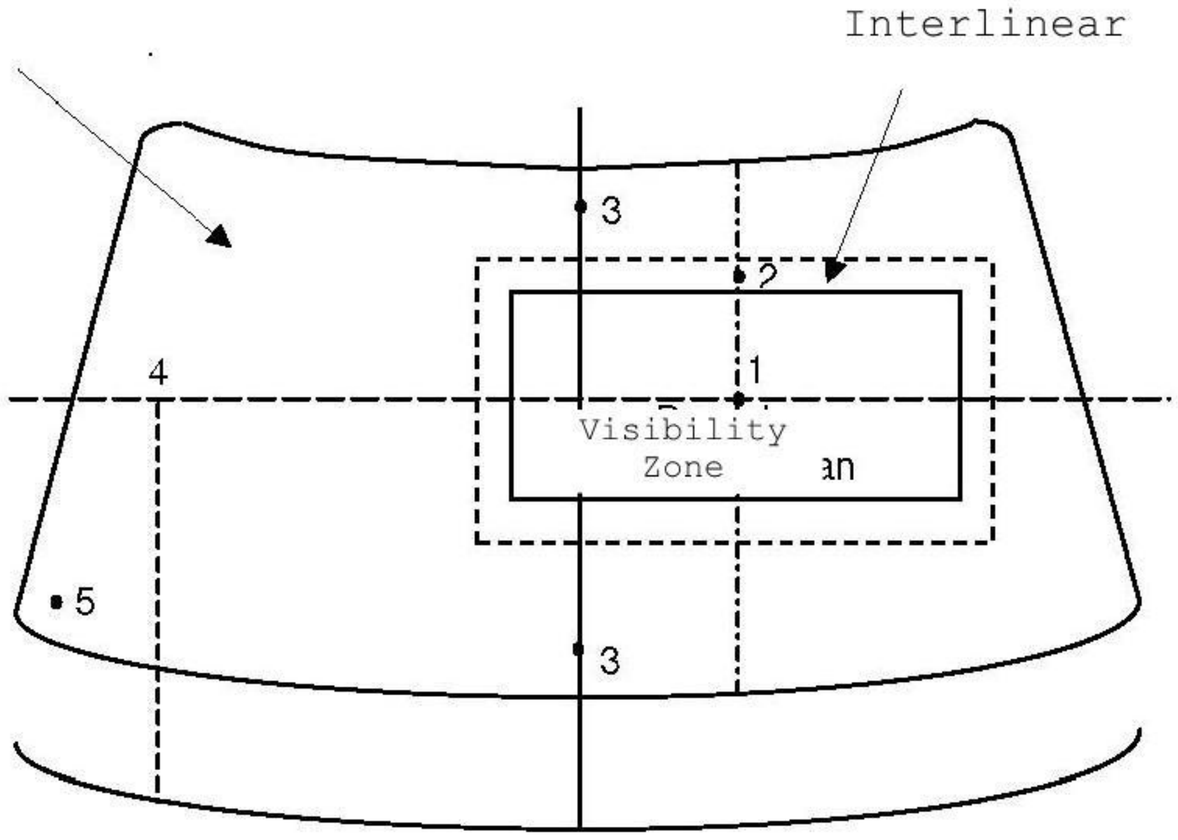


Figure 3

Breaking points position of zone tempered safety glass

6.5 Crash resistance test of fully tempered safety glass or zone tempered safety glass

a) Crash resistance test is performed on sample of tempered safety glass in size of 300 mm x 300 mm.

b) Sample has to be buffered by a solid wood frame to keep the glass surface stays on horizontal position when crash happen as illustrated at figure 4.

c) A steel ball with mass of (225 ± 5) gram with smooth surface and diameter around 38 mm positioned at the altitude as stipulated on table 8, should released freely, where the drop point has to be in the circle in maximum radius of 25 mm from the center. This crash resistance test shall only perform once on glass surface and in room temperature.

Table 8 Crash Resistance Test

in mm

Glass Thickness Classification	Ball's falling point
Thickness ≤ 3.5 mm	2.000
3.5 mm < thickness ≤ 5.0 mm	2.500
Thickness > 5 mm	3.000

in mm

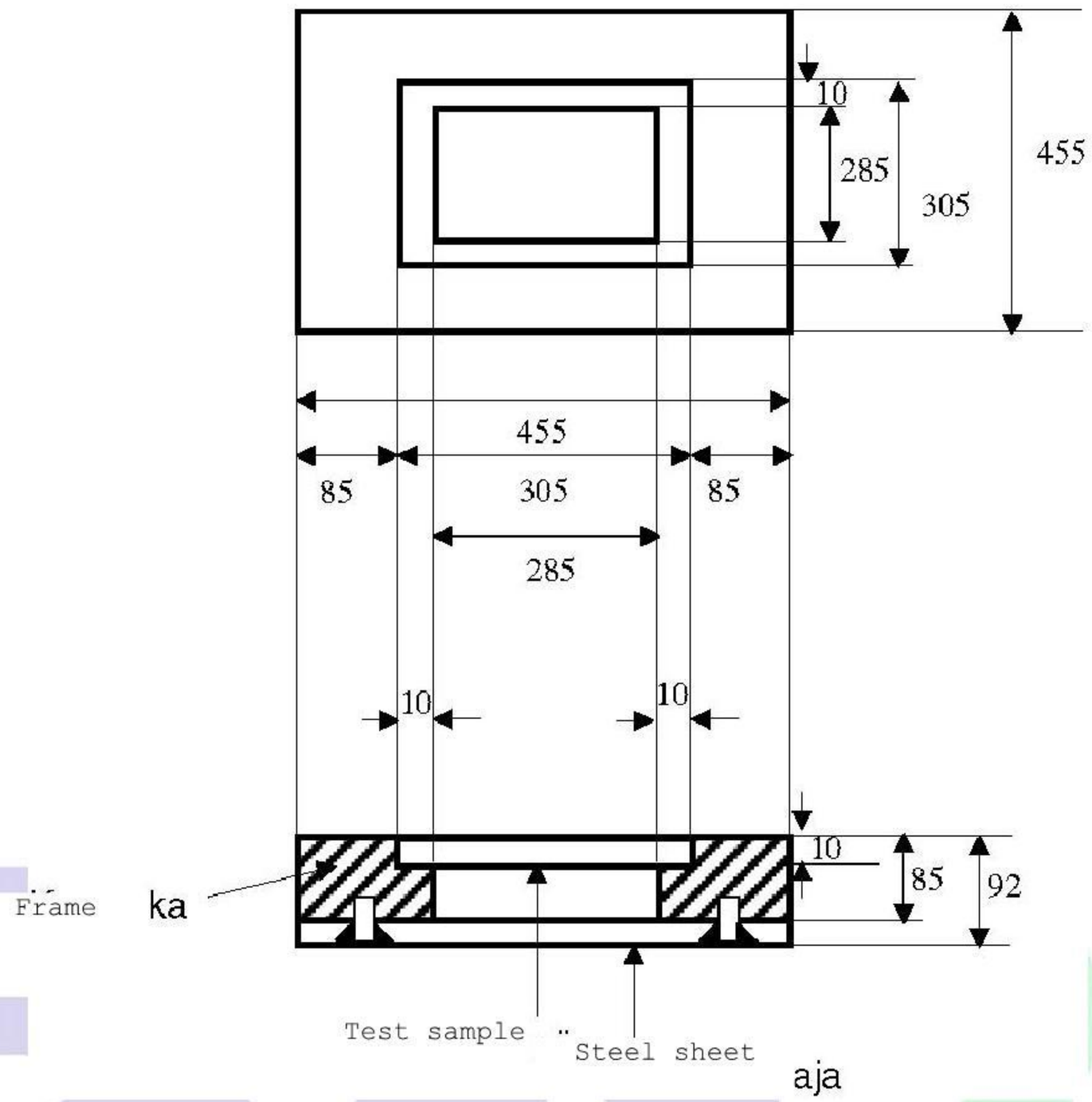


Figure 4 Crash Resistance Tester

6.6 Light Transmission

Light transmission test conducted by standard illuminator, with an incandescent light bulb filled with gas with color temperature of 2854° K. Glass sample should be positioned linear with tolerance ± 5° against the light from this tester. This light transmission test uses untempered safety glass sample (raw glass for making of tempered safety glass) which divided in accordance with required size in order to fit to spectrometer.

6.7 Optical Refraction

6.7.1 Testing Condition

Testing should be done by placing the test sample to form certain angle towards vertical line as in actual position in the vehicle. This testing should also be done in a dark room, so it will easy to see the secondary silhouette and its differences.

6.7.2 Equipments

This equipment consist of box sized around 305 mm x 305 mm x 150 mm. Front part of the box should have center hole with diameter of 12.7 mm and two rings concentric to inner center line of 79.2 mm and 123.5 mm with width of around 2 mm each. Front part of this box may be made of glass covered with black lightproof material or metal sheet which connects the small holes and arranged at 45° with ordinate and abscissa. The box is illuminated with an incandescent light bulb of (15-25) watt. Center hole covered with yellow red light filter, such as red ilford 608 and white paint for inside the box.

6.7.3 Procedures

Light box should be positioned in such way that center of target lies on horizontal line which will pass through the center of windscreen positioned on 7600 mm from light box. Glass sample positioned in certain angle as in actual position on the vehicle with the same altitude and facing to light box. Light box shall be seen through every zones of main visibility zone to determine the existence secondary silhouette in its relation with illumination target. Windscreen laterally shifted cutting the projection line, and maintaining its visibility on fixed horizontal plane at 7600 mm from light box to glass sample in said certain angle. Adjust the arch of secondary silhouette seen at the light box with the support of telescope.

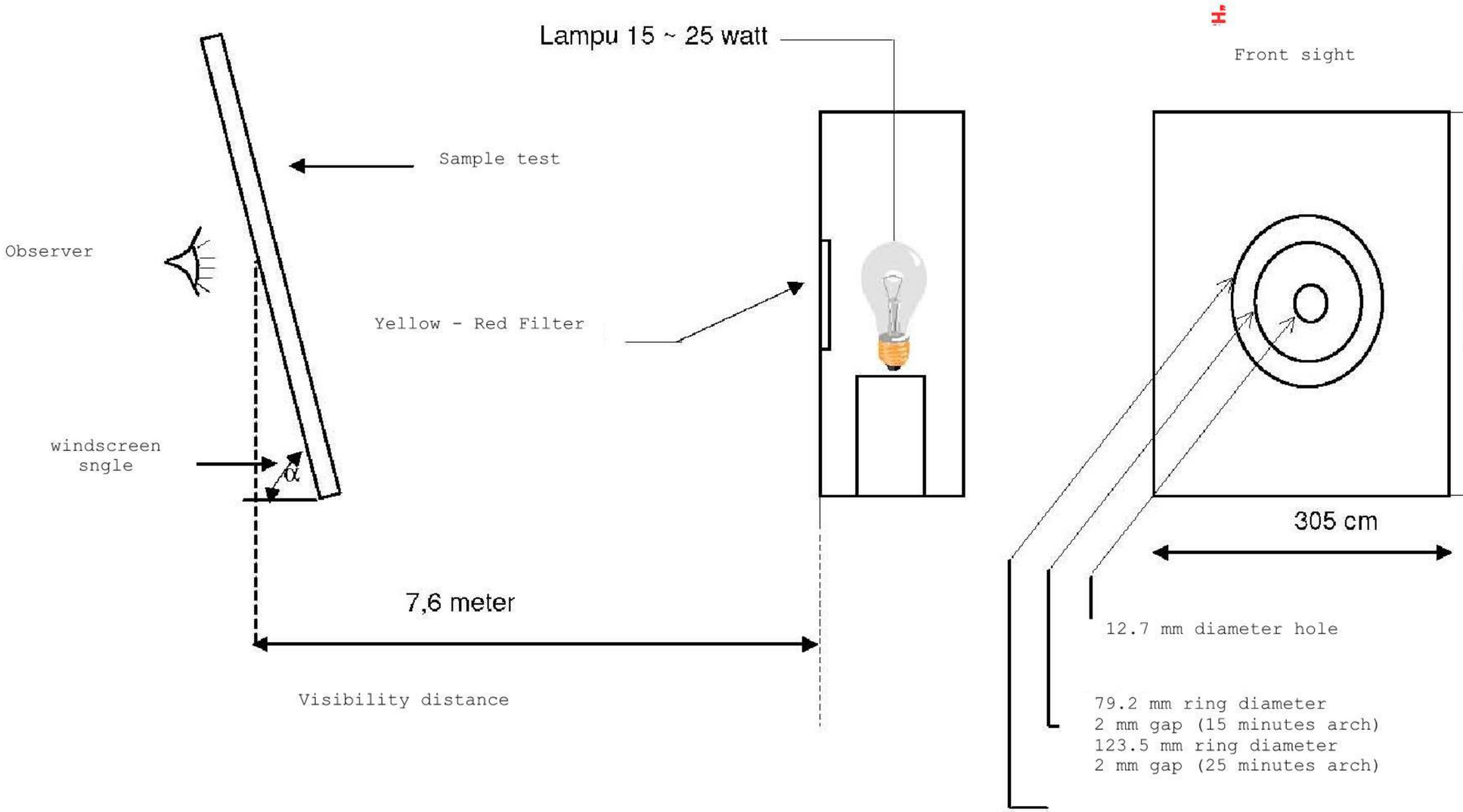


Figure 5

Optical Refraction Tester

6.8 Optical Distortion

6.8.1 Testing Condition

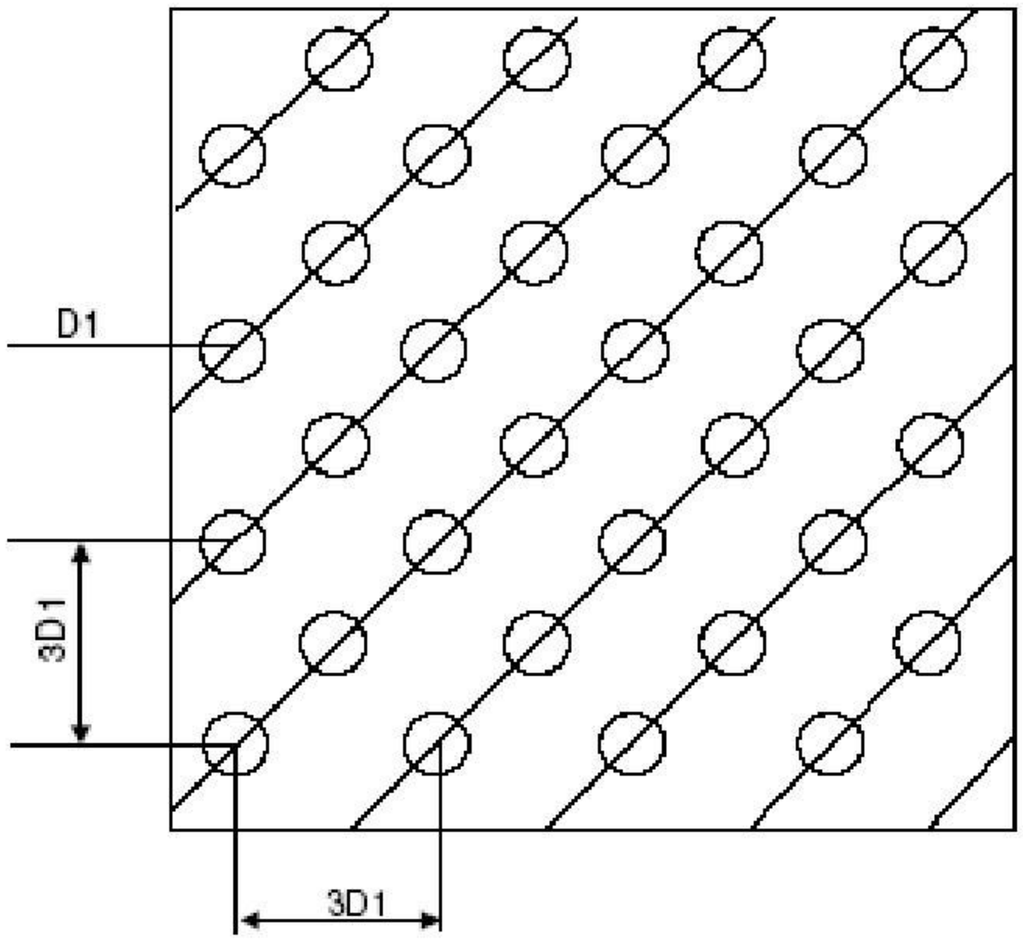
Testing should be done by placing the test sample to form certain angle towards vertical line as in actual position in the vehicle.

6.8.2 Using Circle Projection

6.8.2.1 Equipments

Consist of:

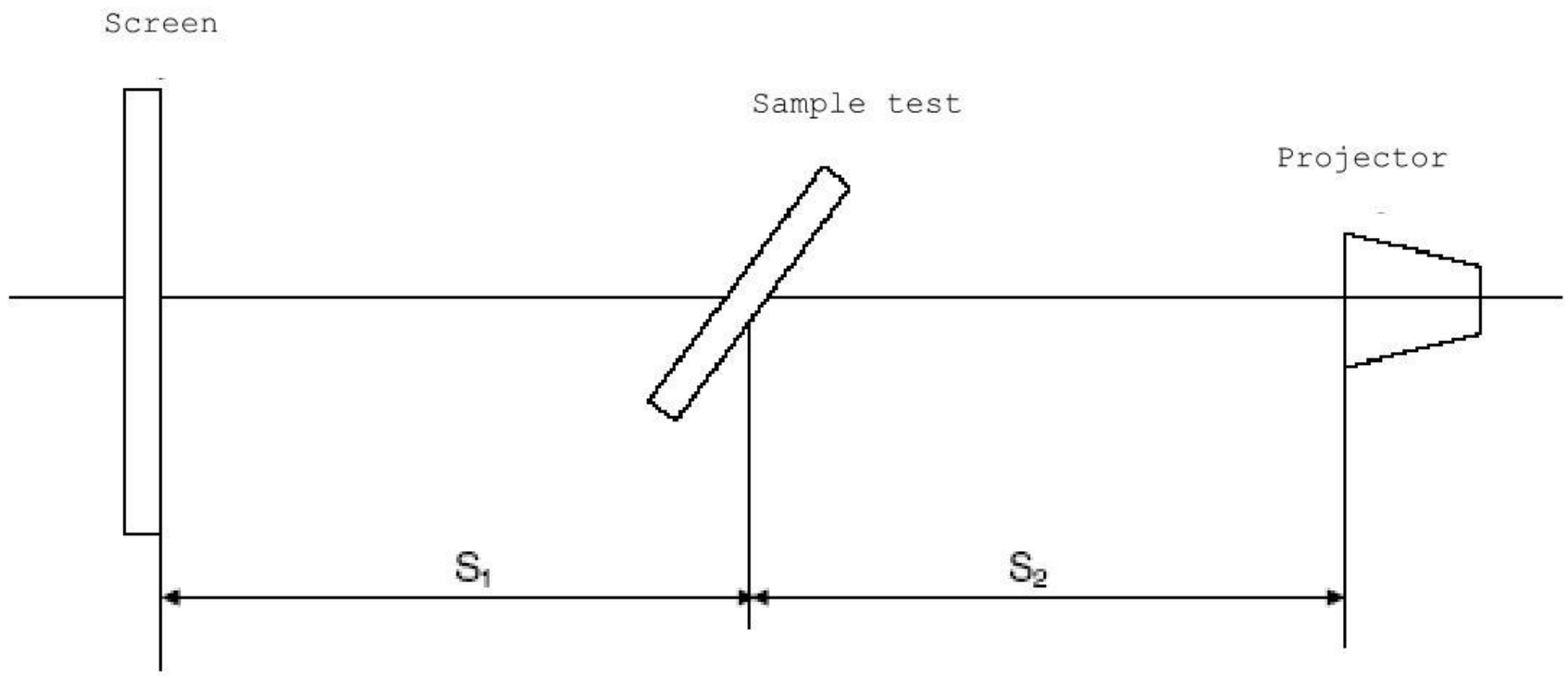
1. A projector lamp which able to project the image clearly at 8000 mm and its focus has been setup.
2. A projector (minimum power of 150 watt) with object lens which had minimum focus of 90 mm shall be appropriate in this testing.
3. Glass buffer with flexible platform.
4. A flat screen.
5. Slide which can provide silhouette on the screen as stipulated below.



Note:

D_1 is circle centerline on the screen.

Figure 6 Circle Projection on the Screen



Note:

S_1 is distance between projector and test sample;

S_2 is direction of test sample to the screen.

Figure 7 Test sample position to the screen and projector

where:

D_1 is circle centerline on the screen;

S_1 is the distance of projector to the test sample;

S_2 is the direction of test sample to the screen.

6.8.2.2 Procedures

Windscreen should be positioned in an angle which conforms with mounting angle in the vehicle facing to the light source at distance of 4000 mm and at 4000 mm to lined screen.

Circles silhouette on the screen should be adjusted so it can be seen clearly by adjusting projector's focus, afterwards, set the diameter of several circles which assumed to be projected by the glass.

Mount the windscreen on glass buffer and moved laterally by cutting projection line in horizontal plane by placing fixedly at the distance of 4000 mm from light box to the glass on said angle. Scrutinize and calculate the margin of silhouette diameter from projected slide to the screen either with glass or with sample and calculate the arch minute's deviation.

6.8.3 Using Lined Screen

6.8.3.1 Equipments

Consists of:

a) A projector lamp which able to project the image clearly at 8000 mm and its focus has been setup.

b) A screen with minimum altitude of 180 cm marked with red lines with thickness of 1.5 mm ± 0.15 mm at distance 21.6 mm ± 1 mm respectively. Said lines are pulled up in oblique with angle of 30° ± 2° towards horizontal side of the screen.

c) The projected slide should be precise and clear forming the silhouettes on lines on the screen and centered on the distance of 8000 mm from the lamp. Slide can be made of by taking picture of its lined screen.

d) In this case is allowed to make minor adjustment on distance between the lamp and the screen, in order to make the silhouettes are really pressed with lines on the screen.

e) Adjust the angle of glass buffer and positioned in the middle of light source and lined screen.

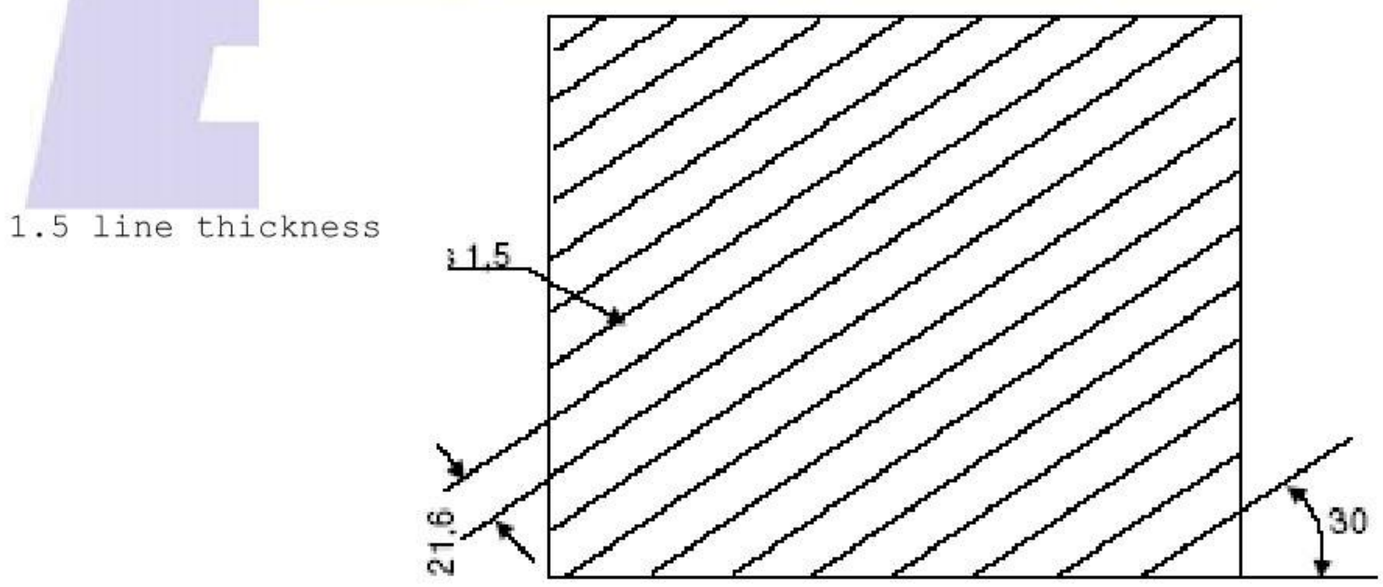


Figure 8 Lined Screen

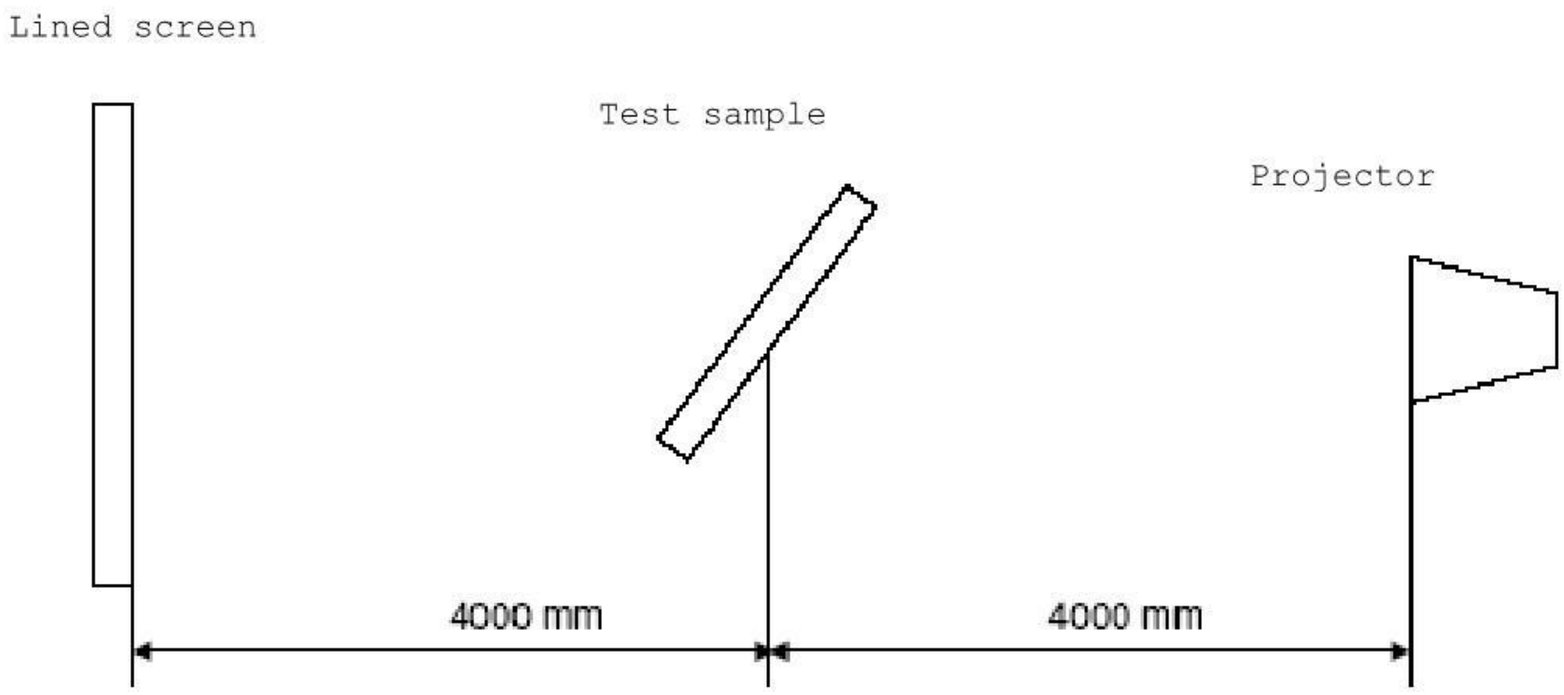


Figure 9

Position of test sample towards lined screen and projector

6.8.3.2 Procedures

A high quality flat glass, with thickness same as windscreen and mounted on the same angle of tested windscreen, positioned between the lamp and screen.

Afterward, said lined screen is adjusted in order to obtain the right silhouette so the projected lines pressed with lines on the screen. The flat glass then removed.

Windscreen should be placed at certain angle facing to the light source at the distance of 4000 mm from lined screen, at the previous place of flat glass.

Windscreen moved laterally by cutting the projection lines. If necessary, spinning to maintain its visibility in horizontal plane by fixedly placing it at the distance of 4000 mm from the light box to windscreen at said certain angle. Slide silhouette then projected through the test sample to lined screen. Scrutinize the lines from slide silhouette position and distance with lines on the screen and calculate the arch minute's deviation.

7 Pass Requirements

7.1 Visible Characteristic

The testing on three sheets of tempered safety glass for road vehicles is in accordance with the testing method at point 6.1. If all test samples fulfill the requirements, the glasses shall be declared have passed the test, if only two sheets fulfill the requirements, please conduct a new testing with three new sheets and if all test samples fulfill the requirements glasses are declared have passed the test.

7.2 Dimension and Tolerance

The testing on three sheets of tempered safety glass for road vehicles is in accordance with the testing method at point 6.2. If all test samples fulfill the requirements, the glasses shall be declared have passed the test, if only two sheets fulfill the requirements, please conduct a new testing with three new sheets and if all test samples is fulfill the requirements glasses are declared have passed the test.

7.3 Flatness

The testing on three sheets of tempered safety glass for road vehicles is in accordance with the testing method at point 6.3. If all test samples fulfill the requirements, the glasses shall be declared have passed the test, if only two sheets fulfill the requirements, please conduct a new testing with three new sheets and if all test samples fulfill the requirements glasses are declared have passed the test.

7.4 Fragmentation

7.4.1 Fully Tempered Safety Glass

7.4.1.1 For Thickness ≥ 5 mm

7.4.1.1.1 Flat or curve fully tempered safety glass with single radius

Three sheets are tested for each thickness.

If tested in accordance with fragmentation test at point 6.4.1.1 then it should comply with the following stipulation:

a) If all test samples fulfill the requirements on table 4, the glasses shall be declared have passed the test.

b) If only two sheets fulfill the requirements, please conduct a new testing with three new sheets and if all test samples fulfill the requirements glasses are declared have passed the test.

7.4.1.1.2 Tempered safety glass total lengkung multi radius

Five sheets are tested for each thickness. If tested in accordance with fragmentation test at point 6.4.1.1 then it should be fulfill the following stipulation:

a) If all or four test samples fulfill the requirements on table 4, the glasses shall be declared have passed the test.

b) If only three sheets fulfill the requirements, please conduct a new testing with three new sheets and if all test samples fulfill the requirements glasses are

declared have passed the test.

c) If only one or two sheets fulfill the requirements, the glasses are declared have failed the test.

7.4.1.2 For Thickness less than 5.0 mm

The testing on three sample sheets is in accordance with the following stipulations:

If tested in accordance with fragmentation test at point 6.4.1.1 or point 6.4.1.2 it should have complies with the following stipulations:

a) If all test samples fulfill the requirements glasses shall be declared have passed the test.

b) If only two sheets fulfill the requirements, please conduct a new testing with three new sheets and if all test samples fulfill the requirements glasses are declared have passed the test.

7.4.2 Zone Tempered Safety Glass

Eight sheets are tested for each thickness. If tested in accordance with fragmentation test at point 6.4.2 then it should be fulfill the following stipulation:

a) If all test samples fulfill the requirements as stipulated in table 5, the glasses shall be declared have passed the test.

b) If only six or seven sheets fulfill the requirements, the glasses are declared have passed the test.

c) If only five sheets fulfill the requirements, please conduct a new testing with eight new sheets and if all test samples fulfill the requirements glasses are declared have passed the test.

d) If only four or less sheets fulfill the requirements, the glasses are declared have failed the test.

7.5 Crash Resistance

Eight sheets of fully or zone tempered safety glasses are tested for each thickness in size of 300 mm x 300 mm. If tested in accordance with fragmentation test at point 6.5 then it should be fulfill the following stipulation:

a) If all test samples fulfill the requirements, the glasses shall be declared have passed the test.

b) If only six or seven sheets fulfill the requirements, the glasses are declared have

passed the test.

c) If only five sheets fulfill the requirements, please conduct a new testing with eight new sheets and if all test samples fulfill the requirements glasses are declared have passed the test.

d) If only four or less sheets fulfill the requirements, the glasses are declared have failed the test.

7.6 Light Transmission

Three test samples uses raw glass for making of tempered safety glass with thickness according to the original tempered safety glass and divided in size adjusted with spectrometer and tested according to testing method at point 6.6. If all glasses fulfill the requirements glasses are declared have passed the test, but if only two sheets have passed the test please conduct a new testing with three new sheets and if all test samples fulfill the requirements glasses are declared have passed the test.

7.7 Optical Deviation

Three fully or zone tempered safety glasses for road vehicles are tested according to testing method at point 6.7. If all glasses fulfill the requirements glasses are declared have passed the test, but if only two sheets have passed the test please conduct a new testing with three new sheets and if all test samples fulfill the requirements glasses are declared have passed the test.

7.8 Optical Distortion

Three fully tempered safety glasses for road vehicles are tested according to testing method at point 6.8. If all glasses fulfill the requirements glasses are declared have passed the test, but if only two sheets have passed the test please conduct a new testing with three new sheets and if all test samples fulfill the requirements glasses are declared have passed the test.

Table 9 Amount of Samples and Pass Requirements

No.	Requirements	Types and Amount of Samples	Pass Requirements
1	Dimension & Tolerance	Actual glass size n=3	Acc=0, Re=1 n=3, Acc=0
2	Visible Characteristic	Actual glass size n=3	Acc=0, Re=1 n=3, Acc=0
3	Flatness	Actual glass size n=3	Acc=0, Re=1 n=3, Acc=0
4	Fragmentation		
4.1	Fully Tempered Safety Glass	Actual glass size n=3	Acc=0, Re=1 n=3, Acc=0
1)	Flat or curve with single radius	Actual glass size n=5	Acc=0, Re=2 n=5, Acc=0 Re≤4, failed
2)	Multi curve radius		
4.2	Zone Tempered Safety Glass	Actual glass size n=8	Acc=2, Re=3 n=8, Acc=0 Re≥4, failed
5	Crash Resistance	Size of test sample is 300 mm x 300 mm, n=8	Acc=2, Re=3 n=8, Acc=0 Re≥4, failed
6	Light Transmission	Raw glass in size of 100 mm x 50 mm or adjusted with sample holder size, n=3	Acc=0, Re=1 n=3, Acc=0
7	Optical Refraction	Actual glass size n=3	Acc=0, Re=1 n=3, Acc=0

8	Optical Distortion	Actual glass size n=3	Acc=0, Re=1 n=3, Acc=0
NOTE n is amount of samples Acc is acceptance Re is rejected			

8 Marking Requirements

Product and product packaging should marked by permanent tag of tempered safety, company's name, and symbol/logo.

9 Packaging Methods

Tempered safety glass for road vehicles should be packed in solid box or pallet, using good silencer and orderly piled in such way to avoid friction between glass sheets.

Appendix A
(Informative)

Optical Testing Zone of Safety Glass for Road Vehicles

A.1 Windscreen

A.1.1 Procedure I (Testing Zone A, B and I based on V and O points)

A.1.1.1 Scope

This procedure explains how to determine Testing Zone for windscreen based on focus V and O and determination of Testing Zone for right hand drive vehicle, and can be used for left hand drive vehicle by changing the positive and negative signs on “Y” coordinate. “In case of absence of R point, Testing Zone will be determined by procedure II”.

A.1.1.2 Definition

A.1.1.2.1 Seat standard point (R point) is H point position (body point or dummy’s feet circle). If dummy placed on adjustable seat or standard position in the design. Seat is positioned at the most rear position (backward or forward, if applicable), at the lowest position (up and down, if applicable) and oblique angle is adjusted according to the design (if the incline of seat cushion is adjustable).

A.1.1.2.2 Vehicle’s center meridian is a straight line as mentioned below, if vehicle is positioned on a flat surface:

(1) Straight line which through the centerline connecting left wheel and right wheel centerlines of front and rear wheels of four or more wheels vehicles.

(2) Straight line which through the centerline connecting left wheel and right wheel centerlines of front and rear wheels of three wheels vehicles.

(3) Straight line equally divides the distance between centerline of tractor’s right and left drive wheel.

A.1.1.2.3 Vehicle’s center meridian plane (S_1). Vertical plane including vehicle’s center meridian plane.

A.1.1.2.4 X-axis, axis line at horizontal plane which through the R point and parallel

with center meridian.

X+: towards vehicle's rear

X-: towards vehicle's front

A.1.1.2.5 Y-axis, axis line at horizontal plane which through the R point and cuts across linearly with X-axis.

A.1.1.2.6. Z-axis, axis line at vertical plane yang which through the titik R and cuts across linearly with X- axis and Y- axis.

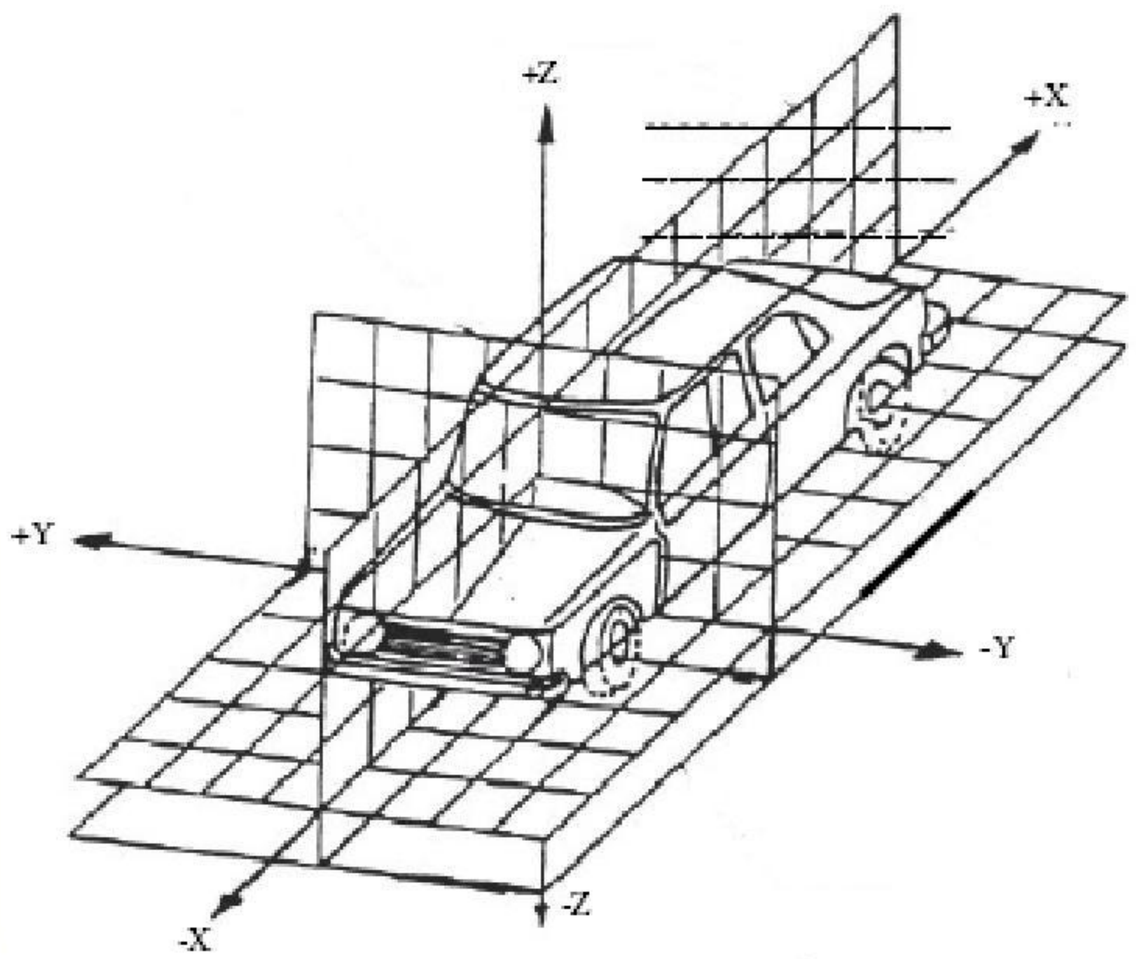


Figure A.1a Vehicle Testing Zone

A.1.1.3 A and B Testing Zone Based on V1 Point

(1) V Point Position

(1.1) V point position obtained by using R point and shifted as illustrated at Table 1 and Table 2, three dimensions orthogonal ordinate system.

(1.2) Table 1 shows basic coordinate for 25° seat cushion incline. Said coordinate direction is as illustrated at figure 3.

Table 1 Basic Coordinate

V Point	X (mm)	Y (mm)	Z (mm)
V_1	68	5	665
V_2	68	5	589

(1.3) Table 2 shows the correction for X coordinate and Z coordinate of Table 1 appendix, if seat cushion design is not 25°, said coordinate direction is as illustrated at figure A.3.

Table 2 Correction of X and Z coordinates

Seat Incline (°)	X Horizontal Coordinate (mm)	Z Horizontal Coordinate (mm)	Seat Incline (°)	X Horizontal Coordinate (mm)	Z Horizontal Coordinate (mm)
5	-186	28	23	-17	5
6	-176	27	24	-9	2
7	-167	27	25	0	0
8	-157	26	26	9	-3
9	-147	26	27	17	-5
10	-134	25	28	26	-8
11	-128	24	29	34	-11
12	-118	26	30	43	-14
13	-109	22	31	51	-17
14	-99	21	32	59	-21
15	-90	20	33	67	-24
16	-81	18	34	76	-28
17	-71	17	35	84	-31
18	-62	15	36	91	-35
19	-53	13	37	100	-39
20	-44	11	38	107	-43
21	-35	9	39	115	-47
22	-26	7	40	123	-52

(2) Testing Zone

(2.1) A Testing Zone is a windscreen surface bordered by four extension planes from V point towards X- point (see appendix at figure A.1b).

a. Parallel plane toward Y- axis which through the V1 and forming 3^{o} angle toward horizontal plane toward Z+.

b. Parallel plane toward Y- axis which through the V2 and forming 1^{o} angle toward horizontal plane toward Z-.

c. Vertical plane which through the V1 and V2, and forming 13^{o} angle toward vertical plane toward Y+.

d. Vertical plane which through the V1 and V2, and forming 20^{o} angle toward vertical plane toward Y-.

(2.2) B Testing Zone is a windscreen surface bordered by four extension planes from V point towards X- point (see appendix at figure A.2).

a. Parallel plane toward Y- axis which through the V1 and forming 7^{o} angle toward horizontal plane toward Z+.

b. Parallel plane toward Y- axis which through the V2 and forming 5^{o} angle toward horizontal plane toward Z-.

c. Vertical plane which through the V1 and V2, and forming 17^{o} angle toward vertical plane toward Y+.

d. Vertical plane which through the V1 and V2, and forming 17^{o} angle toward vertical plane toward Y-.

Area in 25 mm around peripheral zone or 25 mm from inside edge of ceramic is excluded from the above stipulation.

(1) O point position. O point is a point on plane which through the drive wheel system center and parallel toward vehicle's center median plane at the distance of 625 mm from R point on driver's seat position toward Z-

(2) Testing Zone. I testing zone is windscreen surface bordered by four planes as follows:

a. A plane which through the OQ straight line and forming 10^{o} angle toward horizontal plane toward Z+.

b. A plane yang which through the OQ straight line and forming 80^{o} angle toward horizontal plane toward Z -.

c. A plane yang which through the O straight line and forming 15^{o} angle toward vehicle's center meridian toward Y+.

d. A vertical plane symmetrically toward (c) plane and located at Y- direction.

NOTE OQ straight line is horizontal straight line through the O point and perpendicular toward vehicle's center meridian plane.

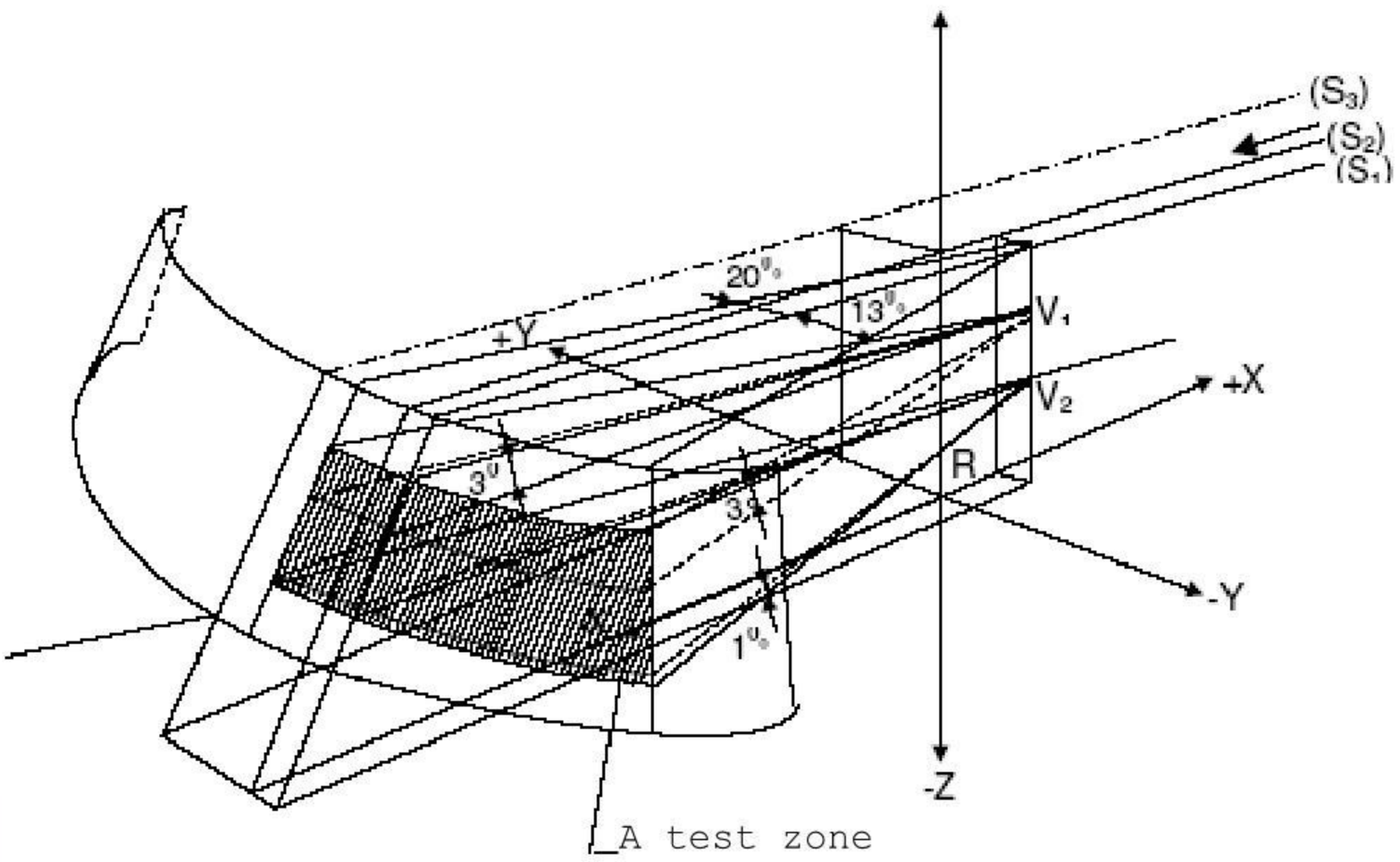


Figure A.1b A Testing Zone

where:

(S_1) is vehicle's center meridian plane;

(S_2) is a plane which through the R point and parallel with (S_1);

(S_3) is a plane which through the V1 and V2 point and parallel with (S_1).

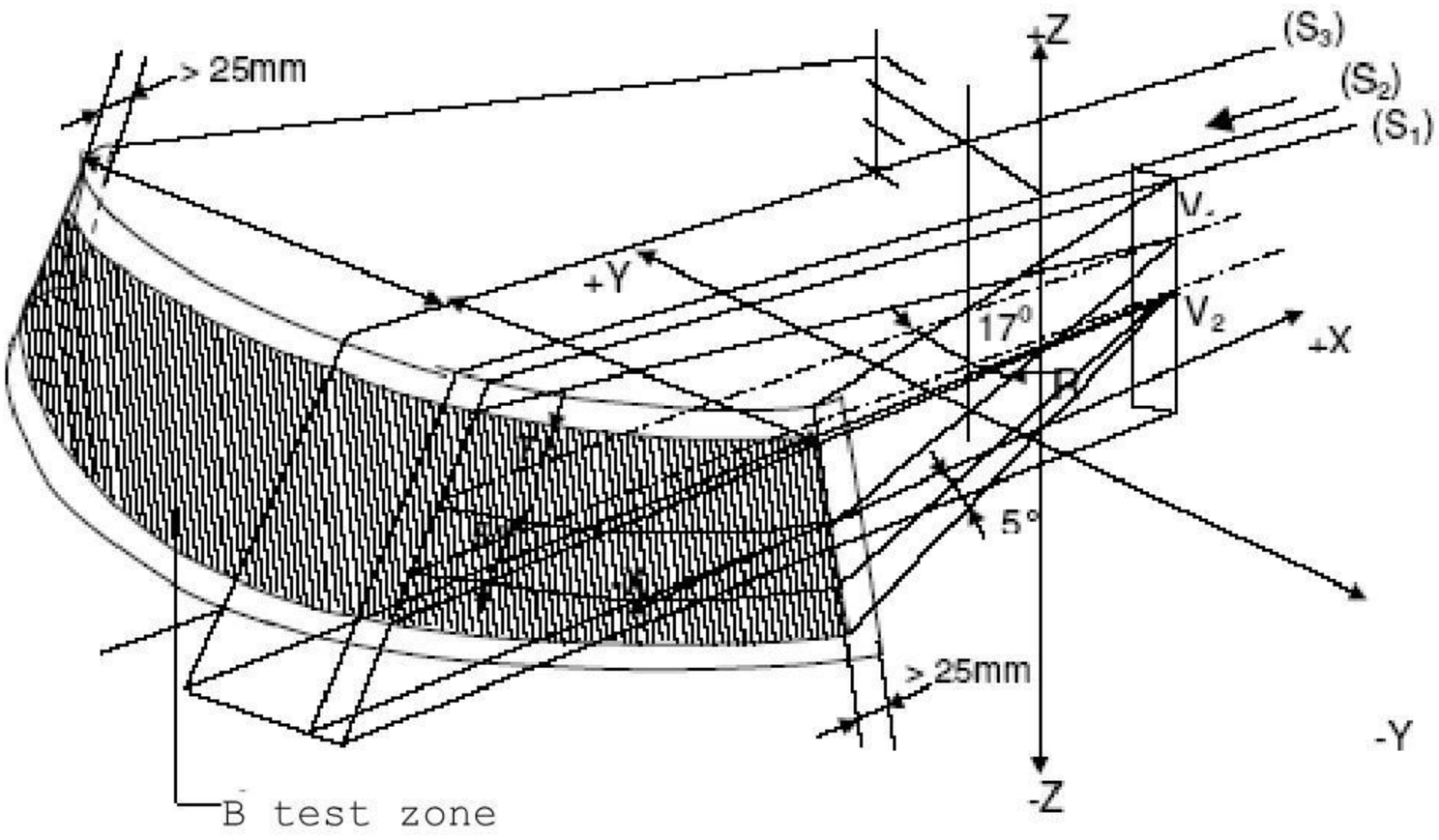


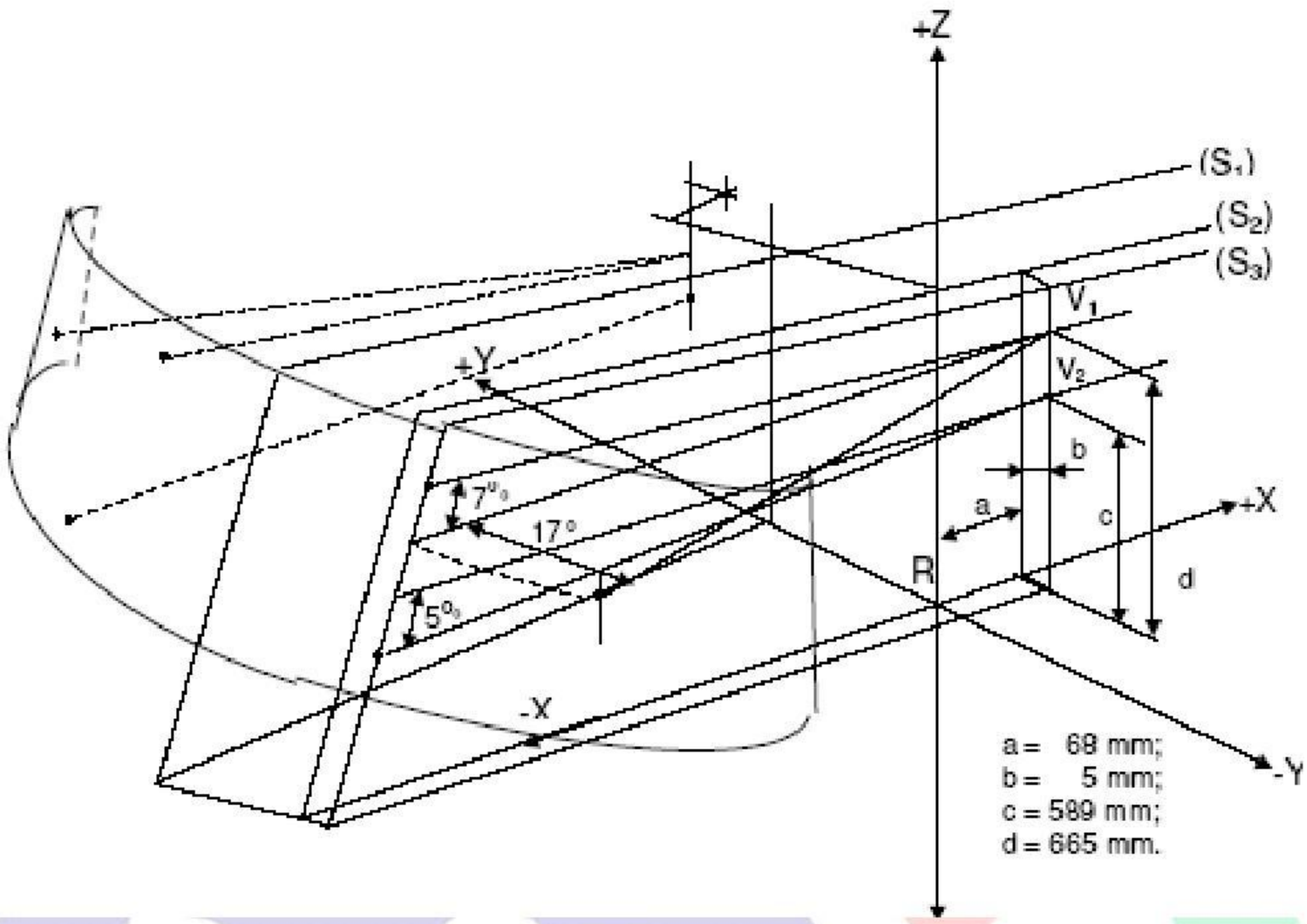
Figure A.2 B Testing Zone

where:

(S_1) is vehicle's center meridian plane;

(S_2) is a plane which through the R point and parallel with (S_1);

(S_3) is a plane which through the V1 and V2 point and parallel with (S_1).



where:

(S_1) is vehicle's center meridian plane;

(S_2) is a plane which through the R point and parallel with (S_1);

(S_3) is a plane which through the V1 and V2 point and parallel with (S_1).

Figure A.3 V point for design of 25° seat cushion incline

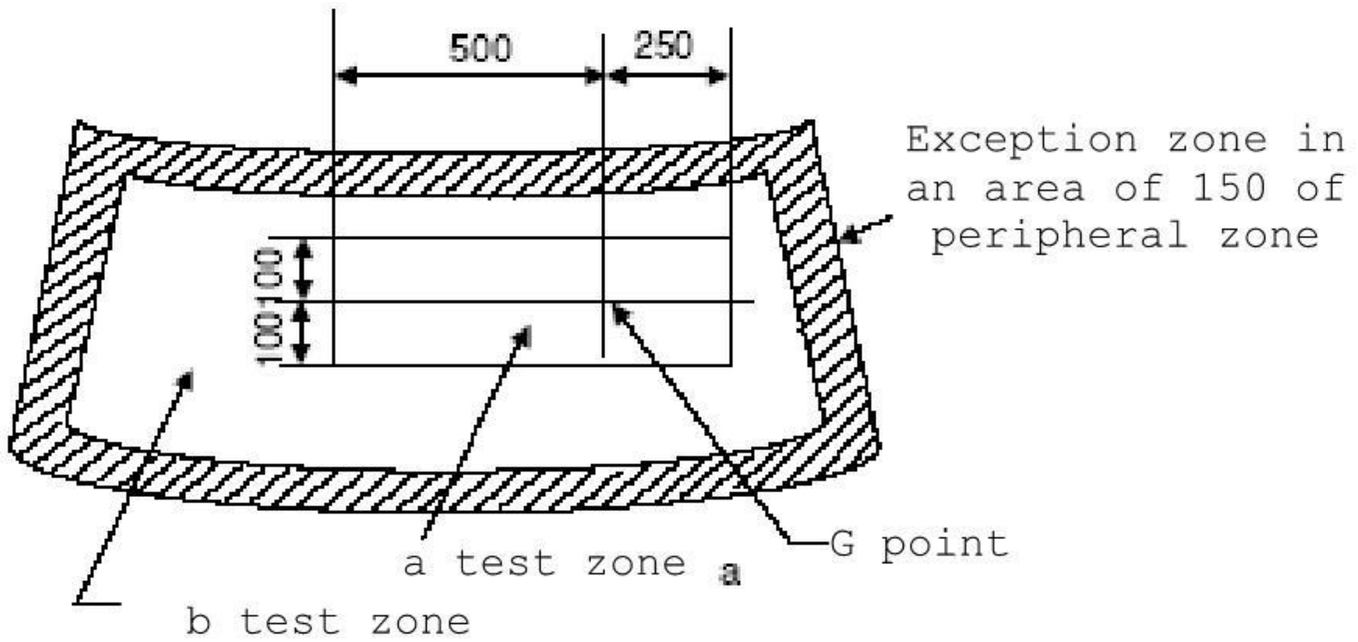
A.1.2.1 Scope

This is to explain the procedure to determine windscreen test zone if V and O points is unusable.

NOTE This testing zones is applied for vehicles where in its normal operation is not operated in public road, such as vehicles for construction project, plantation, forestry etc.

A.1.2.2 a, b and c testing zones

Windscreen test sample intersecting line with straight line which through the driver's sight and parallel with vehicle's center meridian line when the glass mounted on the vehicle, called as G point. a, b, and c testing zones as mentioned on figure A.4 based on said G point.



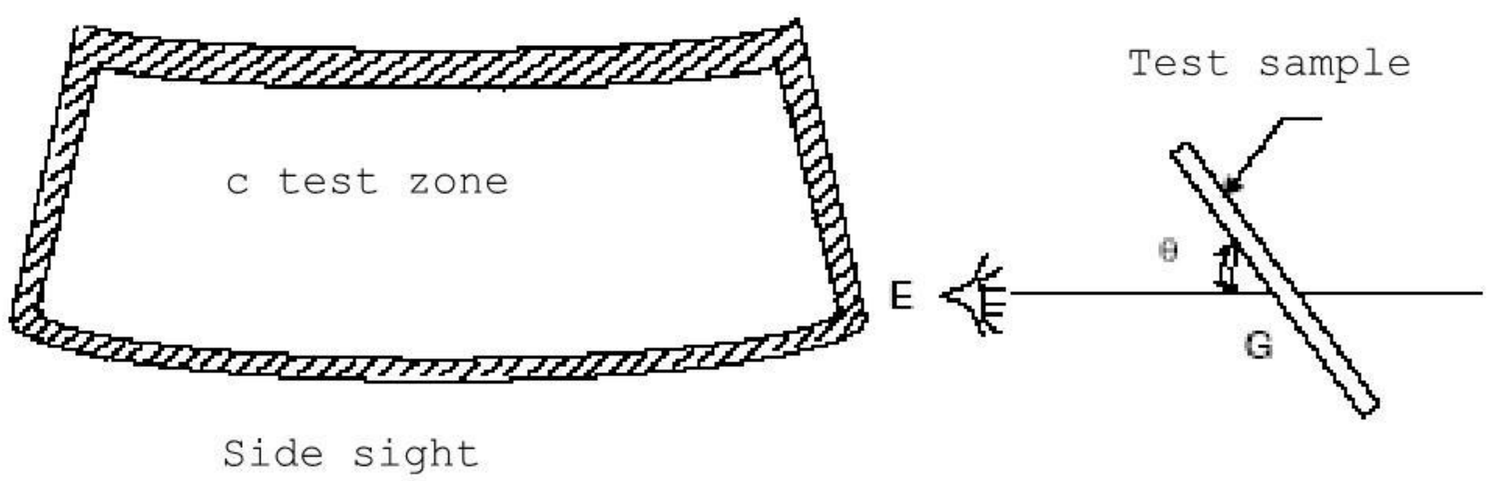


Figure A.4 a, b, and c testing zones

Note:

- a testing zone is 100 mm up and down, 250 mm toward the driver and 500 mm to opposite direction, refer to G point.
- c testing zone is inside zone with distance of 10 mm from mounting frame.
- ἐ is glass mounting incline angle in the vehicle.
- E is driver's sight.

A.2 Testing zone for side window

A.2.1 D and E testing zones for side window (other than glass behind the driver)

(1) D testing zone is remaining zone of side window, if zone stipulated below is expelled (see figure A.5).

a) Glass which touches lower part of the door.

b) Upper part of the line where side window cross over with plane which through V1, X-axis tends to lean to 7^{o}.

c) Zone inside the distance of jarak 10 mm from mounting frame or other parts of body which overlap, and glass zones which overlapped when glass is closed.

d) Marking on the glass.

(2) E testing zone is remaining zone side window, if zone stipulated below is expelled (see figure A.6)

f) Glass which touches lower part of the door.

g) Upper part of the line where side window cross over with plane which through O, X-axis tends to lean to 10°.

h) Zone inside the distance of jarak 10 mm from mounting frame or other parts of body which overlap, and glass zones which overlapped when glass is closed.

i) Marking on the glass.

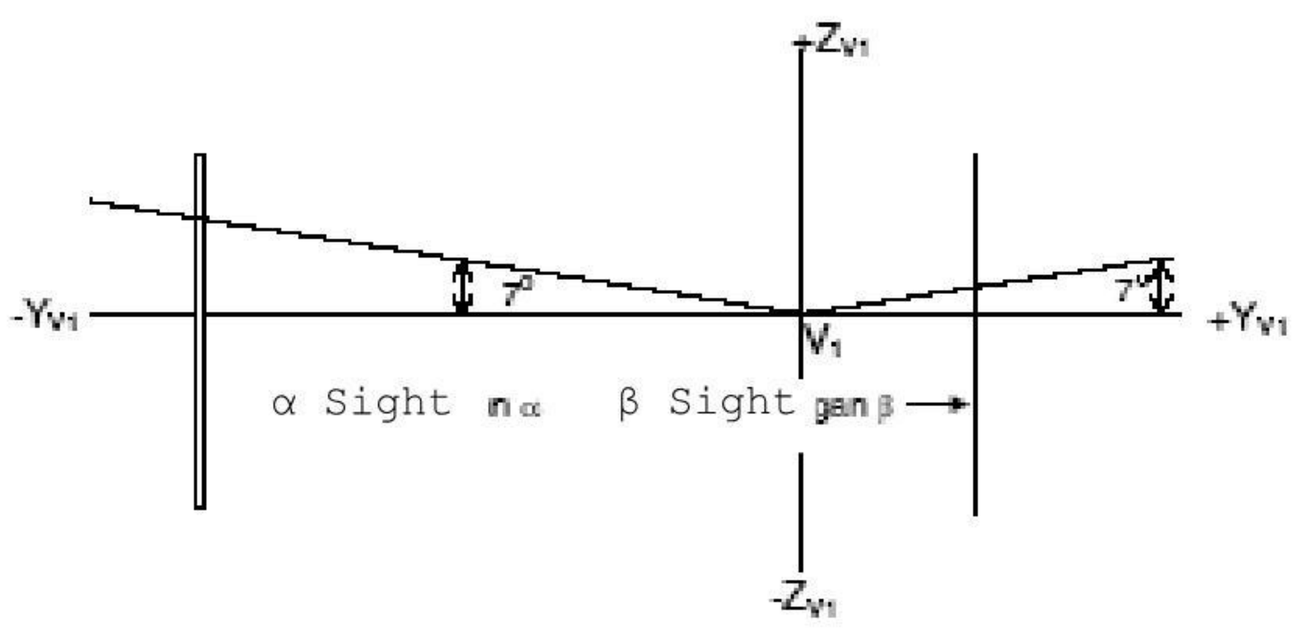


Figure A.5 D Test Zone

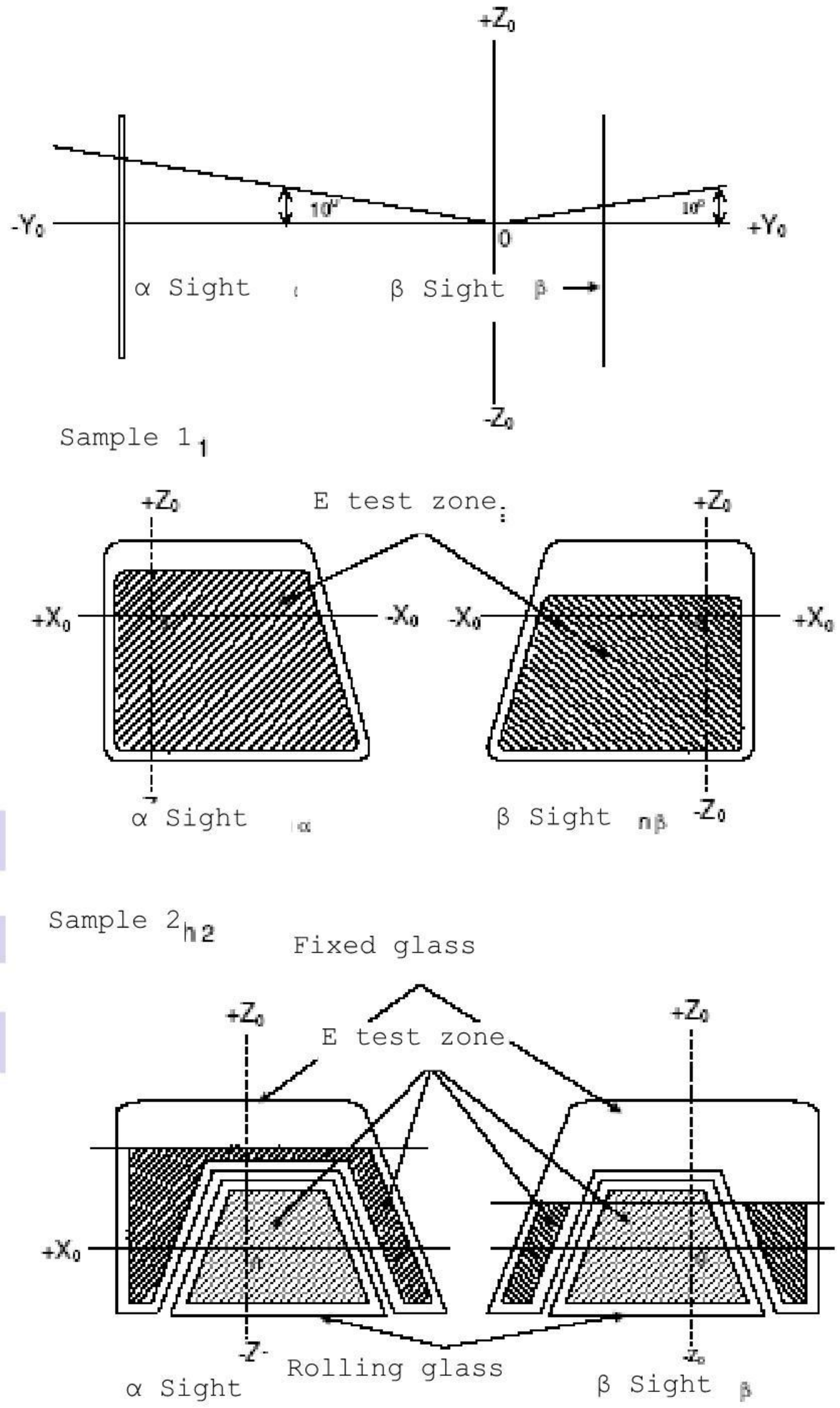


Figure A.5 D Test Zone

Appendix B
(Normative)

Double Sampling

Table B.1 Double Sampling

Total in group which valued	Sample taken		Total cumulative sample	Acceptance standard and limits of accepted/rejected								Note
				0.065		1		4		6.5		
				Pass	Fail	Pass	Fail	Pass	Fail	Pass	Fail	
2 to 8	I	2	2									use the first pass/fail values below the arrow
	II	2	4									
9 to 15	I	3	3									
	II	3	6									
16 to 25	I	5	5							0	2	
	II	5	10							1	2	
26 to 50	I	8	8					0	2	2	3	
	II	8	16					1	2	3	4	
51 to 90	I	13	13					0	3	3	4	
	II	13	26					3	4	4	5	
91 to 150	I	20	20					1	4	4	5	use the first accepted/ rejected values above the arrow
	II	20	40					4	5	6	7	
151 to 280	I	32	32			0	2	2	5	5	7	
	II	32	64			1	2	6	7	8	9	
281 to 500	I	50	50			0	3	3	7	5	9	
	II	50	100			3	4	8	9	12	13	
501 to 1,200	I	80	80			1	4	5	9	7	11	
	II	80	160			4	5	12	13	18	19	
1,201 to 3,200	I	125	125	+	+	2	5	6	11	11	16	
	II	125	250			6	7	18	19	26	27	
3,201 to 10,000	I	200	200			3	7	11	16			
	II	200	400			8	9	26	27			
10,001 to 35,000	I	315	315			5	9					I. First sample II. Second sample Pass = accepted Fail = rejected + Use single sampling
	II	315	630			12	13					
35,001 to 150,000	I	500	500	0	2	7	11					
	II	500	1000	1	2	18	19					
150,001 to 500,000	I	800	800	0	3	11	16					
	II	800	1600	3	4	26	27					
500,001 to above	I	1250	1250	1	4							
	II	1250	2500	4	5							

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